

# A Self-Regulated Learning System with Scaffolding Support for Self-Regulated e/m-Learning

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**Abstract**— The paper proposes a self-regulated learning system with scaffold support for self-regulated e/m-learning. With the support of the self-regulated system, the learner can identify his best way for learning, where a learner can get supports from the environmental resources in a scaffolding manner and improve his performance of self-regulated learning. Based on the self-regulatory learning and scaffolding theories, two subsystems, "Learning Scheduler Subsystem" and "Content Accessibility Subsystem," are proposed. The Learning Scheduler Subsystem helps learners schedule their learning process and enhance the capability of self-regulated learning. With the use of the Content Accessibility Subsystem, the instructor can organize the contents and teaching materials such that different level of supports can be dynamically provided to learners. Comprehensively, the proposed Self-Regulated Learning System not only assists the learner to cultivate his self-regulated learning behavior, but also provides the learner a mobile, portable, and personalized learning environment.

## I. INTRODUCTION

Learning is for everyone of any ages, not only for students or children. The goal of education is not only to let everyone have chances to learn, but also to cultivate one's learning behavior in order to achieve the goal of lifelong learning. As a result, spontaneous, autonomous, and self-regulated learning is much important, especial in the knowledge explosion era. On the other hand, with the progress of modern technology, learning at any time and at any place is possible now. Therefore, it is important to provide learners at anytime and anywhere a learning environment. Consequently, supporting learners a convenient learning system suitable for self-regulated e/m-learning is of crucial importance nowadays.

In recent years, many researchers, educational societies, or governmental departments keep promoting the concept of self-regulated learning. The main goal of the self-regulated learning is to help the learner find his best learning style. Basically, there are four factors to affect the performance of a learning. They are: learning schedules, learning materials, learning scenarios, and learning quality. It is well-known that executing a self-regulated learning is difficult. The reasons in terms of the above four factors are described as follows.

- From the viewpoints of learning schedules and materials:  
The learning materials that a learner can get are limited

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and fractal. It results in the difficulty for a learner to syncretize learning materials. Moreover, if the learner has no good experience in designing learning schedule, all these factors will affect the performance of the self-regulated learning.

- From the viewpoints of learning scenarios and quality:  
The progress of modern technology, such as broadband and wireless networking technology, makes the learning materials easy and fast to obtain. Therefore, in addition to the traditional indoor classroom, the learning environment can be extended to outdoors. The learning schedule can be more flexible as well. However, for the sake of the lack of learning materials, a learner may give up learning when he/she is in an outdoor environment. In addition, a learner may be unable to or forget to record his learning profile due to no suitable device to use. All these factors will affect the performance of the self-regulated learning as well.

Therefore, a learning system which can support mobility for the user is very important, especially for self-regulated learning.

To help the learner learn efficiently and self-regulatively, a self-regulated learning system to support self-regulated e/m-learning is proposed in the paper. The proposed learning system adopts the concept of self-regulated learning cycle [1], [2] to help the learner improve his self-regulated learning. Additionally, one of the important factors affecting the success of the self-regulated learning is the interest of the learner. Too high or too much request may disappoint the learner, even result in the feeling of frustration. Thus, a reasonable goal set for the learner not only increases the interest of the learner, but also motivates the learner's learning. The proposed system also adopts scaffolding theory [3] to help the teacher or the learner to set a reasonable goal for the learner in each process of the self-regulated learning cycle. The success of scaffolding theory in self-regulated learning totally depends on the precise evaluation of learning performance and outcome of the learner. Therefore, in addition to the detailed monitoring of the learner's learning status, an elegant evaluation subsystem is provided in the system as well. Therefore, by the assist of the system, the learner can realize his learning quality and set a reasonable goal. Besides, the learner will become

well acquainted with the control and management of time in designing learning schedule, via experiences repeatedly obtained from each self-regulated learning cycle.

In addition, supporting a learning environment for mobile learners by means of modern wireless networking technology is another purpose of the proposed system. Through mobile learning devices, such as PDAs, Tablet PCs, and so on, the learner can easily get the learning materials without complicated operations using the proposed system. Moreover, the system can also record the learner's learning profile automatically in order to monitor the learning status of the learner. On the other hand, the resource sharing, including learning materials, learning schedules, and so on, are also important in self-regulated learning. The learner can refer to the suggestions of teachers, parents, or companions, to improve his learning performance. Via wireless technology supported by the system, the learner can share his learning resources with others. Of course, the learner can also get help or suggestions instantly.

Combining the concepts of self-regulated learning theory, scaffolding theory, and wireless technology, the proposed self-regulated learning system can not only assist the learner to cultivate his self-regulated learning behavior, but also provide the learner a mobile, portable, and personalized learning environment. Furthermore, let the learner become a lifelong learner.

The rest of the paper is organized as follows. Section II surveys the current research on self-regulated learning and wireless technology. Section III introduces the proposed self-regulated learning system. Section IV describes the expected effects on the system users. Finally, Section V concludes the paper.

## II. BACKGROUND

In this section, we first mention much previous research related to the self-regulated learning, and then address several promising wireless technologies such as WLANs and WPANs, which are able to improve the performance of self-regulated learning.

### A. Self-Regulated Learning Theory

Self-regulation is a learning model, where a learner can revise his goal via the monitor of the learning processes. The main purpose of such model is for a learner to efficiently improve his learning performance. Numerous studies which focus on self-regulated learning have been proposed [4], [5], [2], [6], [7]. In [4], self-regulated learning is defined as the behavior and course of learning, which systematically guides learners to achieve their learning goal. The course of self-regulated learning includes three major phases such as *self-monitoring*, *self-instruction*, and *self-reinforcement*.

Self-regulated learning is also regarded as a process involved the means of learning self-control and self-instructing [5]. Such process comprises many sub-processes, including *goal-setting*, *cognitive preparation for action*, *behavior*, *monitoring*, *judgement*, and *self-evaluation*. In [2], five useful skills

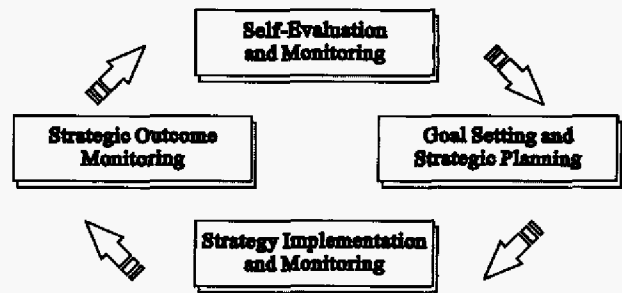


Fig. 1. A cyclic model of self-regulated learning[2].

for self-regulated learning are proposed. The skills are *time planning and management*, *text summarization*, *note taking*, *test preparation*, and *writing*. Basically, self-regulated learning is for a learner to achieve self-training and know the content of learning by the extension of conventional learning approaches such as the assignment, exercise, and homework [7].

Fig. 1 shows a self-regulated learning model, which is based on the above learning skills. The model has four inter-related processes, including *self-evaluation and monitoring*, *goal setting and strategic planning*, *strategy implementation and monitoring*, and *strategic outcome monitoring* [2]. The model efficiently assists a student in self-examining and self-evaluating his learning performance. Once setting up the goal, a student is able to revise his learning strategy to enhance the learning performance according to the variations in learning. Generally, students draw up and carry out their learning plans by themselves in these processes. Thus, such cyclic model really enables students not only to decide the learning by themselves, but also to fulfil their voluntary learning.

### B. Wireless Technologies

The applications of technologies in learning are addressed in [8]. With the aid of the technologies, students can perform efficient learning and achieve remarkable performance. With the progress of communication techniques and the ability of mobile computing, numerous wireless technologies such as 3G, WLANs, and WPANs are now in widespread used in a variety of applications including home, campuses, airports, battlefields, disaster areas, etc [9], [10], [11], [12]. Such technologies have also enabled the evolution of numerous techniques in learning [13], [14]. Among these technologies, WLANs and WPANs are much suitable for self-learning due to the constraints on cost and radio range [15], [16].

IEEE 802.11, a major WLANs standard, is becoming a promising way employed in several circumstances in recent years. IEEE 802.11 provides two operating modes, *infrastructure* and *ad-hoc* modes. In an infrastructure network, a controller, called *access points* (AP), are responsible for communications between any two devices, and handling devices roaming around the network. However, for lack of APs, devices in an ad-hoc network should achieve communications by self-configuring and self-organizing manners [15]. The home and the school, in general, are the places where the capability to self-regulate naturally appears [2]. Students can conveniently

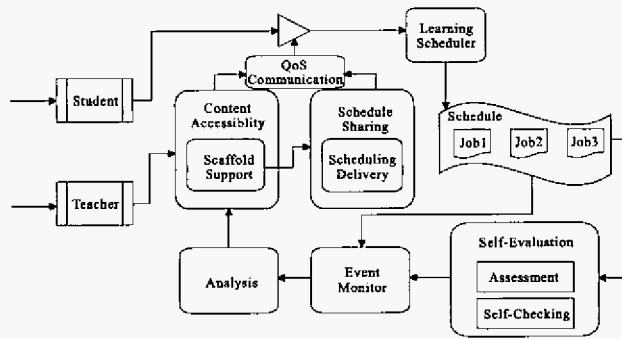


Fig. 2. The configuration of the Self-Regulated Learning System.

gain the learning resources via Internet or wireless networks. Additionally, the WLAN also enables students to share the learning resources and to make ad-hoc discussions with others, especially in a school. Besides of WLAN, WPAN is also one of the promising wireless technologies. Among the majority of existing WPANs technologies, Bluetooth and ZigBee are two popular standards that are likely to apply to self-regulated learning.

### III. THE PROPOSED LEARNING SYSTEM

Generally, self-regulation emerges from two essential sources, including social and self-directed experiences. Such experiences are resulted from the interactions between a person with his parents, teachers, coaches, friends, and classmates distributed either at home or in school [17]. Thus, our system mainly aims to assist learners in providing the learning materials and gathering their learning behaviors in the above environments. Additionally, our system also provides a sustained and circulative self-regulated learning training because a learner is able to develop or display his self-regulatory skill through exercising the personal choice or control [18]

Fig. 2 illustrates the configuration of the proposed scaffolding-support self-regulated learning system, whose key feature is the circulation of learning. The main purpose of the circulation is to assist a learner in achieving an efficient self-regulated learning.

In the course of the learning, a learner first draws up his learning plan based on the assignments from instructors as well as his ability and requirements. Because a good self-regulated learner must constantly self-monitor the learning outcomes and vary his learning approach to get rid of the intervening events [19], [20], our system also allows the learner to monitor his learning behaviors, such as studying period, studying habits, and resources searching for self-evaluation.

In the proposed learning system, we design two modules, *assessment* and *self-checking* modules, for a learner to evaluate his learning either during or after a learning process. Both the underestimation of the difficulty of the test and overestimation of the preparation may incur the disappointing performance [21], a learner, thus, requires evaluating the learning result by means of the objective and subjective criterions. The assessment approach prepared by the instructor can be directly

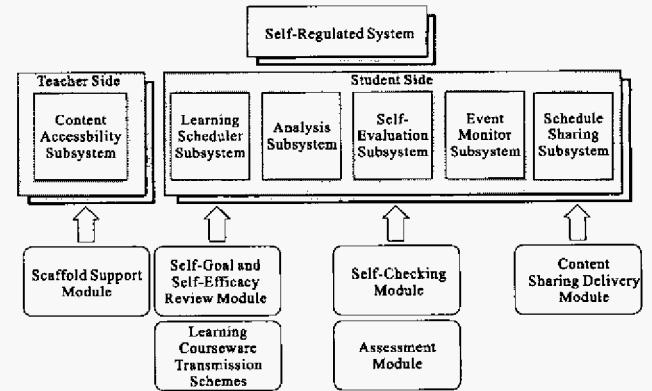


Fig. 3. The architecture of the Self-Regulated Learning System.

used for a learner to identify his objective learning result, whereas the self-checking module enables a learner to self-check his subjective learning result. Under the consideration of the comparison between the assessment and self-checking results, a learner is able to recognize his learning attainment and correct his learning approach for the future learning.

At the end of a learning process, a learner can receive his learning analysis. Based on the analysis, our proposed system is able to assist a learner in adjust his schedule in future learning and provide the suitable learning materials since a learner has to repeatedly undergo the self-regulated learning process for the development of his self-regulatory skill.

Fig. 3 shows the architecture of our self-regulated learning system. The system primarily has two parts, including the teacher and student sides. The subsystems involved in the system are described in detail as follows.

#### A. Content Accessibility Subsystem

In such subsystem, we develop an interface shown in Fig. 4 for the instructor to setup the accessibility of the content of the courseware according to the results generated from the Analysis Subsystem. An instructor enable to arrange the assessment, review the courseware, plan the learning schedule, and import many useful schedules from other learners. Additionally, the subsystem also creates a learning schedule template for the Learning Scheduler Subsystem. A learner is able to design a new appropriate schedule conveniently by means of such template.

In the Content Accessibility Subsystem, the Scaffold Support Module is introduced to realize the dynamic control of courseware. Such module adjusts the content accessibility of the courseware by the scaffold learning theory, in which the concept of scaffolding can be viewed as a social constructionism [22]. The theory suggests that students play the leading roles in the learning process. In general, instructors provide the necessary materials and supports for students, while students develop their own understanding and take on their major responsibility. According to the result from Analysis Subsystem, the module is able to provide the information to teachers and students by adjusting the content of the courseware and the learning schedule, respectively.

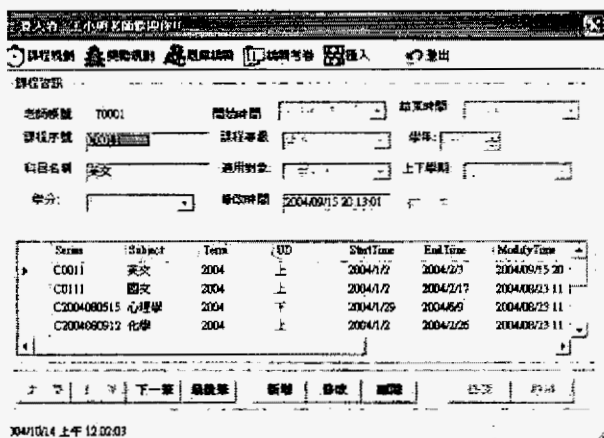


Fig. 4. The interface of Content Accessibility Subsystem.

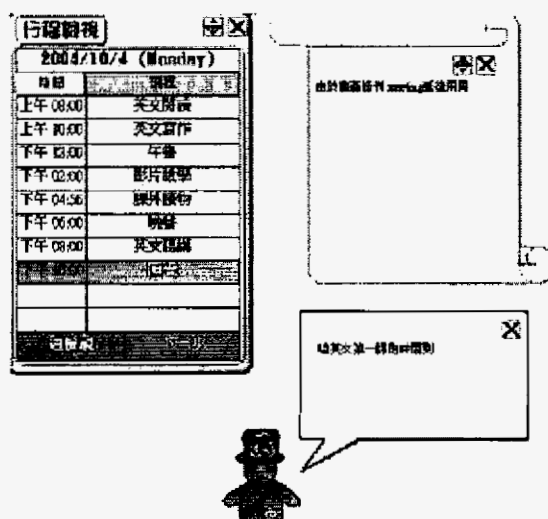


Fig. 5. The interface of learning review tool in Learning Scheduler Subsystem.

### B. Learning Scheduler Subsystem

Learning Scheduler Subsystem is designed for learners to schedule their learning processes. Based on the learning schedule template from Content Accessibility Subsystem, learners are able to arrange their learning processes conveniently and accurately. After scheduling a learning, a learner can review his learning schedule via the learning review tool. The announcements from instructors are also considered in the tool. Moreover, a reminder agent is provided in the tool, whose main goal is to remind learners of their learning. The interface is shown in Fig. 5

The Self-Goal and Self-Efficacy Review Module mainly presents the performance of a learner. According to the overall evaluation, the instructor and learner are able to review the learning goal and efficacy, respectively. The information will be kept in the profile of the learner and be used for future learning.

### C. Self-Evaluation Subsystem

The Self-Evaluation Subsystem, to help students realize their learning statuses, requires to work during and after the learning. The statuses are obtained by the Assessment and Self-Checking Modules mentioned as follows.

- **Self-Checking Module:** The module provides an interface for students to self-check their learning achievements. A checklist, including the work items he has done, how well this work is done, and the load of the work, is provided. By using the Self-Checking Module, a learner can realize his learning status, and the information will be recorded in his own learning profile.
- **Assessment Module:** The module allows instructors to design their test papers, homework, exercises, and so on. The module will also record the status of the assessment of each student, and write the assessment into the learning profile of the respective student.

### D. Analysis Subsystem

The subsystem is designed to analyze learners' learning behaviors. We analyze the potential requirements (e.g., particular learning situations) and then define the norm of self-regulated ability of the target learners will be surveyed. With the aid of the analysis results, the Scaffold Support Module is able to adjust the content of the courseware and the learning schedule.

### E. Event Monitor Subsystem

The most important performance control process that distinguishes skillful from naive self-regulators is self-monitoring[20]. We, hence, paid lots of attentions to design the subsystem. In the subsystem, a particular domain and learning situation (e.g., the tasks and learners involved) will be specified in considering. The subsystem is able to collect learning behaviors based on the specified information. Two kinds of user behaviors, scheduling and learning, are observed for Analysis Subsystem.

### F. Schedule Sharing Subsystem

The main goal of the subsystem is to assist students in sharing their learning schedules with others by means of the QoS-Aware Communication Module. Such module helps instructors and students transmit learning courseware as well. Basically, the module provides several communication primitives, such as QoS routing, broadcast, and multicast. The primitives can be used in the environments, including homes, classrooms, hot spots, and so on. The learner or instructor is able to get the learning resource conveniently via these primitives.

## IV. EXPECTED EFFECTS

Self-directed language learning is composed of three major strategies, including planning, monitoring, and evaluating [23]. Thus, in the paper, we adopt the English learning course to evaluate the performance of the proposed self-regulated learning system. The experiments are made in the manner of the comparison.

All learners are divided into three groups, which are categorized by the different learning methods. In the first group,

all learners use the self-learning method and the instructor only assigns the scope of the learning to the individual learner. Unlike the first group, the second group focuses on the interactions between the instructor and the learner. The instructor not only provides the learning schedule template and learning resources, but also requests the learner to record his own learning process. Similar to the second group, the last one further involves the proposed system to assist the instructor and the learner in providing the learning resources and achieving the efficient learning, respectively.

Preliminary experimental results show that the performance of the learner in the third group is superior to that in the other ones. Furthermore, the learning model of the second group outperforms that in the first group. Obviously, the phenomenon is resulted from the implementation of self-regulated learning, the obtainment of the learning resources, and the record of the learning process.

Compared to learners in the other groups, learners in the first group achieve inefficient learning for lack of resources and with less self-control. With the aid of the instructor, the learners in both the second and third groups are able to obtain more learning resources and realize their own learning processes. Especially, the proposed system can analyze the statuses and further make the schedule for learners according to their learning processes. Thus, learners can fulfil the well performance in learning with the support of the proposed system. Although preliminary results demonstrate that the proposed system really benefits learners in learning, we will proceed with the experiments and make the further analyses to validate the performance of the self-regulated learning and the effectiveness of the proposed system.

## V. CONCLUSIONS

In this paper, a self-regulated learning system with scaffolding support for self-regulated e/m-learning is proposed. The system combines the wireless technology and self-regulated learning model to cultivate a self-motivated, self-directed, and self-regulated learner. The peculiarity of the system is to construct a mobile, portable, and personalized learning environment with scaffolding support and feedback in self-regulated learning cycle for self-regulated e/m-learning at anytime and anywhere. With the system support, the learner can start self-regulated learning wherever he is and whenever he likes, obtain learning materials and assistances instantly, realize his learning style, cultivate his self-regulated learning behavior, and, ultimately, become a lifelong learner.

Currently, experimental studies are ongoing in three classes of English course in a senior high school with the involvement of the teachers. Formative and in-depth evaluations are undertaken. The impacts of the proposed system on the learners of any ages and of any educated levels are to be assessed in the future.

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